Common Built-In-Test Evaluation Criteria

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Mr. Kerry Westervelt

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BIT Fundamentals

- What is BIT?
  - MIL-HDBK-2084: The self test hardware and software which is internal to a unit to test the unit
- Why we have BIT & health monitoring
  - Provides fault detection and isolation of failures
  - Supports on condition maintenance; servicing and inspections
- V-22 BIT implementation
  - Start-up BIT
  - Periodic BIT
  - Initiated BIT
  - Maintenance BIT

BIT Philosophy

- Maintenance environment **(primary function)**
  - BIT provides detection and isolation of failures
  - IBIT used to troubleshoot and verify repair
  - Troubleshoot BIT indications post flight to verify readiness for next mission

- Mission performance
  - Aircrew runs IBIT at pre-flight to verify system is operational
  - PBIT monitors system status in-flight
  - Aircrew can adjust mission by reconfiguring equipment based on failure indications

BIT Philosophy Cont'd

- Maintenance personnel only want to be told when equipment is broken so they can repair it
  - Remove broken WRAs and install good WRAs
  - Repair wires as required
- Maintenance can not repair software anomalies
  - Can not duplicate because aircraft shutdown then powered up
- Do not present engineering data that will confuse the maintainer

BIT Definitions

- Fault detection
  - Fault detection is a confirmed hardware failure associated with a recorded BIT indication
    - A hardware failure must occur
- Fault isolation
  - Fault isolation is a BIT indication of a detected failure that identifies the correct faulty WRA
    - Correct WRA must be identified and must be the first WRA removed
    - Operationally, pubs can be used to supplement BIT fault isolation
- False alarm
  - False alarm is a BIT indication of a failure when no failure exists
    - BIT indication set but no failure present
    - Can I replace a part and fix the aircraft? If the answer is "No" the indication is a false alarm
    - Retest OK at vendor

V-22 Diagnostics Mechanization

FAULT DETECTION AND ISOLATION

- BUILT-IN TEST
- THRESHOLDS & FILTERING
- TEST SENSORS
- PANEL DISCRETE FAIL INDICATIONS
- MULTIPLEX COMMUNICATION CHECKS
- FALSE ALARM FILTERING

FAULT MANAGEMENT

- FAULT REPORTING; MIL-STD-1553, RS422 & ARINC 429 MUX BUSES
- MISSION COMPUTER COLLECTS, REPORTS & STORES FAULT DATA
- VIBRATION, STRUCTURAL LIFE AND ENGINE DIAGNOSTICS

COCKPIT FAULT REPORTING

- MULTI FUNCTION DISPLAY INTEGRATION
- WARNINGS, CAUTIONS & ADVISORIES
- WRA FAIL INDICATIONS
- DIAGNOSTICS CONTROL
- MEMORY INSPECT

FAULT RECORDING

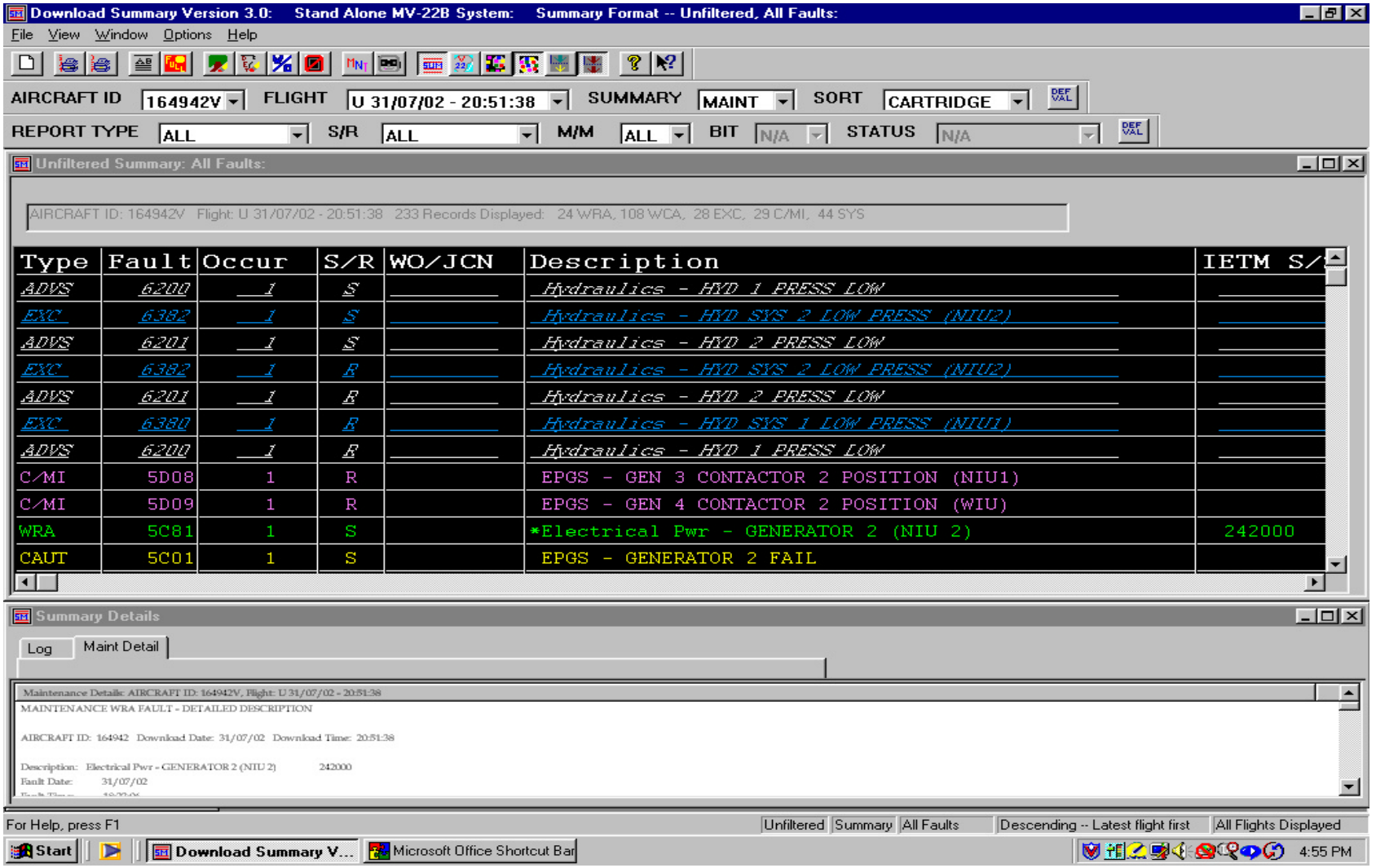
MAINTENANCE DATA LOADER	BATTERY ASSISTED NON-VOLATILE MEMORY
• POST-FLIGHT FAULT RECORDING	• STORES IN-FLIGHT DIAGNOSTICS

AIRCRAFT MAINTENANCE EVENT GROUND STATION (AMEGS)

- PILOT/MAINT DEBRIEF
- DIAG/MAINT ANALYSIS
- NALCOMIS 00MA
- HISTORICAL DATA
- IETM S/S/S CODE
- PWR BY THE HOUR
- ENGINE TRENDING
- DYN COMP MONITORING

DIAGNOSTICS DATA TO DEPOT

AMEGS Report



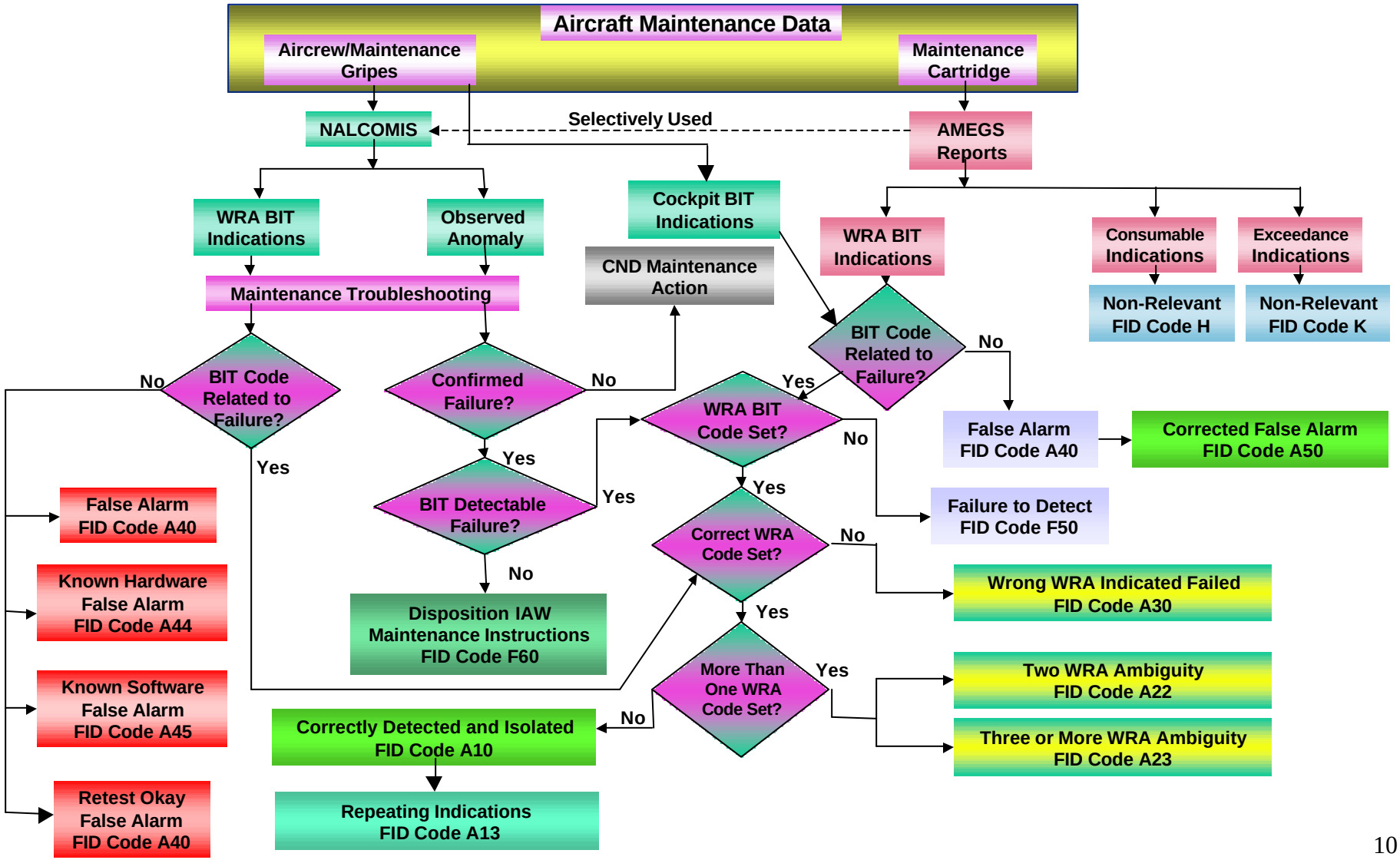
Aircrew Debrief of AMEGS Report

- Pilots bring the maintenance data loader into maintenance control
- Maintenance personnel will download the maintenance and vibration, structural life, engine diagnostic data into AMEGS
- Maintenance control and shops will debrief BIT indications with the pilots using the following AMEGS reports:
  - Weapons replaceable assembly report – Identifies the equipment that has set failed during the mission.
  - Consumable indication report– Identifies the systems that require servicing.
  - Exceedance report– Identifies the systems that have experienced an overstress condition and require inspection.

Aircrew Debrief of AMEGS Report Cont'd

- Pilots will generate a work order through AMEGS into the Naval Aviation Logistics Command Management Information System - Optimized Organization Maintenance Activity based on BIT indications

BIT Scoring Logic



Common Scoring Misconceptions

Issue	Logic	Risk
1. Operator induced indications should not be included in BIT performance: – Connectors left off – Circuit breakers pulled	No failure exists; operator error caused an inoperable condition Legitimate test points for non-destructive fault insertion testing	Reduce fault isolation
2. Software should not be included in BIT performance - Uncommanded mode change - Video anomalies	BIT not designed to detect software anomalies; only checksum failures and control/status bus failures (remote terminal hardware failure- no communication)	Reduce fault detection Artificially inflate BIT performance

Common Scoring Misconceptions Cont'd

Issue	Logic	Risk
3. MUX bus failure indications should not be included in BIT performance • Aircrew need to know when functionality is lost (power cycle to regain operation)	Majority caused by software anomalies; a. No hardware failure exists b. No WRA removed	Artificially inflate BIT performance
• Maintenance can not repeat gripe on ground (power cycle occurred when aircraft shutdown)		Reduce fault isolation (Bus controller or remote terminal failed?)

Common Scoring Misconceptions Cont'd

Issue	Logic	Risk
4. Equipment not installed should not cause BIT indications and then resets as GO	No failure exists; equipment not installed	Artificially inflate fault detection
	Equipment not installed so no failure can exist	Increases false alarms (Dependent upon how long equipment intentionally left removed)
5. Repeated indications during flight should not be used in BIT performance calculations	One indication scored per flight because maintenance can only fix a failure one time per mission	Artificially inflate fault detection/isolation
	Aircrew workload from repeated false alarms is a separate deficiency from BIT performance	Increases false alarms